DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 3

Topic :- Electromagnetic Waves

1 **(a)**

Use method of dimensions. Equating the dimensions of two sides we note the relation (a)Is dimensionally correct

2 **(d)**

On the basis of dual nature of light, Lious de-Broglie suggested that the dual nature is not only of light, but each moving material particle has the dual nature. He assumed a wave to be associated with each moving material particle which is called the matter wave. The wavelength of this wave is determined by the momentum of the particle. If p is the momentum of the particle, the wavelength of the wave associated with it is

$$\lambda = \frac{h}{p}$$

Where h is Plank's constant.
Since, it is given that, alpha, beta and gamma rays carry same momentum, so they will have same wavelength.

3 **(b)**

Velocity of photon in vacuum is constant for all frequencies

4 **(c)**

A changing electric field produces a changing magnetic field and $vice - versa$ which gives rise to a transverse wave known as Electromagnetic Wave. The time varying electric and magnetic fields are mutually perpendicular to each other and also perpendicular to the direction of propagation of this wave.

5 **(d)**

Energy of a photon $E = \frac{hc}{\lambda}$

$\therefore$ Wavelength $\lambda = \frac{hc}{E}$

$$= \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{13.2 \times 10^{3} \times 1.6 \times 10^{-19}}$$
$$= 0.9375 \times 10^{-10} \text{ m}$$

$= 1$ Å

Wavelength range of X-rays is from 10^{-11} m to 10^{-8} m (0.1 Å to 100 Å).
Therefore, the given electromagnetic radiation belongs to the X-ray region of electromagnetic spectrum.

6 **(c)**

Equation second shows that the electromagnetic wave travels along the positive x-axis

7 **(b)**

$$B = \frac{\mu_0}{4\pi}\frac{2i_D}{r} = \frac{\mu_0}{4\pi} \times \varepsilon_0 \frac{d\phi_E}{dt}$$
$$= \frac{\mu_0}{2\pi}\frac{2i_D}{r} = \frac{\mu_0}{4\pi}\frac{2}{r} \times \varepsilon_0 \frac{d\phi_E}{dt}$$
$$= \frac{\mu_0 \varepsilon_0 \pi r^2 dE}{2\pi r dt} = \frac{\mu_0 \varepsilon_0 r}{2}\frac{dE}{dt}$$

9 **(c)**

$E = \frac{hc}{\lambda}$; minimum the wavelength, the maximum the energy of a λ ray. Therefore rays have minimum wave length

10 **(d)**

$$V = \frac{hc}{e\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 10^{-10}} = 10{,}000 \text{ V}$$

11 **(b)**

$\psi_{(x,\,t)} = 10^3 \sin \pi(3 \times 10^6\, x - 9 \times 10^{14}\, t)$

$= 10^3 \sin 3 \times 10^6\, \pi(x - 3 \times 10^8\, t)$

Comparing it with the relation

$\psi_{(x,\,t)} = a\sin \frac{2\pi}{\lambda}(x - ct)$; We note that

$c = 3 \times 10^8 \text{ ms}^{-1}$

13 **(a)**

Solar radiations are transverse Electromagnetic waves. The central core of the sun emits a continuous Electromagnetic Spectrum.

14 **(c)**

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \quad \text{or} \quad \frac{1}{\mu_0 \varepsilon_0} = \text{c}^2$$
$$= [\text{M}^0\text{LT}^{-1}]^2 = [\text{M}^0\text{L}^2\text{T}^{-2}]$$

16 **(c)**

Speed of Electromagnetic Waves in vacuum

$= \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = \text{costant}$

17 **(c)**

Number of oscillator in coherence length

$= \frac{l}{\lambda} = \frac{0.024}{5900 \times 10^{-10}}$

$= 4.068 \times 10^6$

18 **(d)**

Electric energy density

$$u_e = \frac{1}{2}\varepsilon_0 E_{\text{rms}}^2$$

$$E_{\text{rms}} = \frac{E_0}{\sqrt{2}}$$

$$u_e = \frac{1}{4}\varepsilon_0 E_0^2$$

19 **(a)**

$d = \sqrt{2hR}$ or $d \propto h^{1/2}$

20 **(a)**

For an Electromagnetic Wave (in vacuum),

Velocity $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = 3 \times 10^8 \text{ ms}^{-1}$

Air acts almost as vacuum, hence

$a = 3(\text{approx})$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	A	D	B	C	D	C	B	B	C	D
Q.	11	12	13	14	15	16	17	18	19	20
A.	B	B	A	C	B	C	C	D	A	A